"Water Quality Assessment of Riverine in Baddi, Himachal Pradesh"

SYNOPSIS

Submitted in partial fulfillment of the requirements for the award of the degree of Ph.D.

Submitted by

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Introduction:

Water being the basic necessity of life of every creature, in the absence of pure water the healthy and long life on the earth is not possible. It boots energy and gives important nutrients to the body therefore, having an important role to keep the population alive. Our survival depends upon three basic resources- water, air and soil. Nature's three valuable gifts to mankind. Among which water is the important component as it forms the basic medium for origin of life. (Dwivedi, 2017)

In recent years, the middle-class population has risen in India and China due to economic development. (Baye et al., 2012; Furi et al., 2011; Jalali et al., 2009) It results in rapid industrialization and urbanization to meet the demands of bloomy population. The urbanization and economic growth are interrelated and any increase in the former tends to enhance the environmental problems leading to deterioration of environment. (Rathor, 2016) The Bad environmental quality leading to severe health problems in recent years through contaminated water, soil and air. (Ali et al., 2018) Out of these, the subject of water pollution has become a matter of great concern to the society, in fact the world is facing a deep threat due to the visible continued reason of mismanagement. The major problem for the pure water availability has been attracting the attentions of research scholars.

No doubt 72% the earth is covered by the water and out of which 96.5% water is available in the oceans. It is also a matter of fact that in Asia more than 140 million of population is lacking to have access to safe drinking and useable water which is otherwise a worsening aspect and needs to be looked into deep scholarly studies and continuous researches on the subject. The worst position has also been reported in African countries where water problem is the maximum and days are not far away India may also fall a victim to this problem. Water Quality Index (WQI) is regarded as one of the most effective way to communicate water quality (Pradhan et al., 2001).

The beginning of the 19^{th} century witnessed a fast growth of cities affecting the lifestyle of people, but many ecosystems turned into irreparable causalities. (Herriot and Thisse, 2000) In the recent years, Global economy has achieved substantial economic and social development. Although, urbanization, together with population growth has not only amplified the production of waste, but has also increased the problems linked with its removal, treatment and control. (Rathor, 2016)

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Surface waters are most precious natural resource which is important to sustain life but surface waters are most vulnerable to pollution due to their easy accessibility for disposal of waste waters. (Kunwar et al., 2004) Rivers and other rivulets are the main constituent of the surface water and they play major role in transporting, assimilation and carrying off the municipal and industrial pollutants. Now water pollution in India has reached to a critical point. Almost every river system in country is now polluted to a considerable extent. and the major chunk of the population is forced to drink and use this impure and polluted water. (Dwivedi, 2017)

Without any doubt, Industrialization is a main pillar for developing economy of the country. The Baddi-Barotiwala-Nalagarh (BBN) area in Nalagarh tehsil of Solan district is the biggest industrial hub of the state of Himachal Pradesh has witnessed rapid industrialization since 2003 and now Baddi has become the center of numerous enterprises and many trade exercises.(Report.2014) But the rising unplanned industrialization and their weak governance system adding toxic pollutants which intensely striking the water resources of the area, therefore the rivers and riverine of Baddi area are degrading gradually. So, the water front presents another gloomy scenario which lead to the concept of DYING WATER.

The chemistry of water is an important factor determining its use for irrigation, domestic and industrial purposes.The hydrochemistry of water in a region is influenced by natural processes, such as precipitation inputs, erosion, weathering of crustal materials, as well as the anthropogenic influences namely urbanization; industrial, mining and agricultural activities; and increasing exploitation of water resources (Carpenter et al., 1998; Jarvie et al., 1998). Due to more anthropogenic factors it's important to study the hydrochemistry of major riverine like Balad Khadd, Ratta Khadd, Manpura Khadd and Bagbania Khadd of Baddi area which ultimately meet to Sirsa River.

Literature Review:

In Indian philosophy water is mentioned as VARUN DEV, the God of water. According to Vedic literature the whole universe is an interplay of the energies of Panch Bhootas which means five elements- earth, air, water, fire and sky. Through the Vedic perceptive high ranking has been given to the importance of water. In Rigveda one of the hymns mention that,

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"May the water available from the skies as rain, the water available in the culverts/ canals, water flowing in streams and rivers and the water flowing towards the ocean be instrumental in increasing my happiness"

As the survival of life is not possible without water so it's important to save it. But in the present scenario the quality of water is the main issue of concern for the mankind. A lot of researches have been done in this field but the renewal of impure of water is the paramount demand of the day and it can only be solved by long term researches.

Vallee et al., 1972 described the biochemical effects of mercury, cadmium and lead on the living organisms with their complexation ability and chemical reaction with biomolecules. Perry et al., 1974 reported that the heavy metals such as cadmium, lead, mercury and arsenic have the capacity to affect adversely the activity of a living organism, growth, health, life span, and reproduction performance. The 1977 Conference contributed greatly to the strengthening and co-ordination of international co-operation in studying and assessing water resources. It also stimulated the development of national investigations and attracted the attention of the general public, governments, planning agencies and decision makers to many problems of management and also future development in the hydrological sciences, UNWDM, 1977.

Bhargva, 1987 discussed the different myths for uniqueness of river Ganga. The Ganga, symbolizing Indian culture and civilization is regarded by the Hindus as the holiest amongst the rivers, and it is the Indo-Gangetic plain's most significant river owing to its mighty basin and course, and extraordinarily high self-purifying powers.

One of the most important roles of lakes and reservoirs is as a source of water for direct human consumption, agriculture, industrial use and hydropower. Meaningful development must be sustainable development. Water resources must therefore also be managed sustainably. Clarke, 1994 explained the value of lakes and reservoirs, their deterioration and restoration in the book "The pollution of lakes and reservoirs".

Tariq et al., 1996 described the status of pollution of heavy metals in the Indus river of Pakistan and further it was reported that the level of metal pollution of fresh water bodies, especially the river, is no longer within safe limits for human consumption. One of the most visible tragedies by industrial water pollution was Minamata diseases, methyl mercury poisoning caused by eating contaminated fish in Minamata

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Bay, Japan since1956. This tragedy has provided many lessons which have shaped the scientific field in environmental research, especially in the area of water quality (Kudo et al., 1998).

Yechieli et al., 1998 in the "Will the Dead Sea die?" has submitted that the level of the Dead Sea (the lowest surface on Earth) is currently declining at a rate of 0.8 m/yr, and has dropped about 20 m since the beginning of the twentieth century; it reached -410 m in 1997.Nitrate of groundwater pollution due to urban waste and industrial effluents usually centers around cities. The nitrate levels in groundwater over vast agricultural areas can be correlated with intensive irrigated agriculture. Corresponding use of nitrogenous fertilizers and groundwater development and consequent diffuse agricultural pollution has already endangered the safety of potable groundwater for future generations in both rural and urban area. (Agrawal et al., 1999)

Kunwar et al., 2004 assessed the multivariate statistical techniques for the evaluation of spatial and temporal variation in water quality of Gomti river. Since, rivers constituents the main inland water resources for domestic, industrial and irrigation purposes, it is imperative to prevent and control the river pollution and to have reliable information on quality of water for management.

Mirgane et al., 2009 demonstrated the physio-chemical analysis of Industrial effluents in Thane region of Maharastra, India. In the district industrial waste waters discharged into natural water bodies like river, creeks have created new pollution problems. Toxic chemical compounds have killed aquatic biota in many water bodies and have rendered waters useless. A systematic study has been carried out to assess the water quality index of River Ganga in Haridwar District. The Ganga water contained highest dissolved oxygen during winter season, followed by a gradual decrease to its lowest values during monsoon season. The higher concentration of dissolved oxygen during winter season was probably due to low water temperature. (Joshi et al., 2009) The dense unplanned industrial establishments have negatively affected the ground water quality in the BBN area. The disposal of untreated effluents from various industrial units may be the source of ground water contamination. (Kamaldeep et al., 2011)

River water is of great importance in the global hydrological cycle and for the supply of water to human kind. The riverine ecosystem performs a wide range of functions

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with many intrinsic values or changes and fresh water has become dumping sites to emanate pollutants. Six mains khadd / riverine in Baddi and two in Nalagarh has been reported and all these riverine meets to Sirsa river. Therefore, Sirsa river is the ultimate recipient of all the industrial effluents as well as domestic waste. (Chauhan et al., 2013)

Haridwar is one of the important tourisms of Uttarakhand and it has gained its importance as an industrial town with the establishment of Bharat Heavy Electrical Limited (BHEL) and other industries at Ranipur. Physico-Chemical Analysis of Municipal Wastewater Discharge in Ganga River, Haridwar District of Uttarakhand, India has been examined by Shirin et al., 2014.The samples were analyzed using the Standard Methods (APHA, AWWA, and WCF 1998).

The study was carried out on evaluation of Narmada River of Madhya Pradesh. (Piplode et al., 2015) It was reported that Narmada river is the key source for drinking, domestic and irrigation and its physico- chemical parameters were determined asper standard methods of APHA (2002). It was concluded that the Narmada river water was within the acceptable range and safe for domestic and irrigation purposes. Singh et al., 2015 developed an overall water quality index (OWQI) to classify the surface water into different categories which help the water management authorities to maintain good health of surface water resources. Several univariate and multivariate statistical techniques were used to evaluate and interpret a water quality data from the Markanda River within the state of Himachal Pradesh and Haryana, India. Higher values of EC, BOD and COD indicate that river water is not safe for drinking purposes as prescribed by Bureau of Indian Standards (BIS). (Chadetrik and Kumar, 2015)

On Earth, the freshwater riverine ecosystem is most important factor to life for sustaining human populations. This fraction of freshwater ecosystem is an extraordinary in high level of biodiversity which is directly supported through the range that includes running waters in rivers, lakes and availability of seasonal wetlands. However, the riverine ecosystems face habitat loss and degradation which has become threatened in many rivers from the intense of anthropogenic activities. (Divya et al., 2016)

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The appraisal of surface water quality to ascertain its utility in such ecologically sensitive areas is need of the hour. The present study envisages the application of multivariate analysis, water utility class and conventional graphical representation to reveal the hidden factor responsible for deterioration of water quality and determine the hydrochemical facies and its evolution processes of water types in Nalagarh valley, India. (Herojeet et al., 2017). The quality assessment is made by estimating different parameters within the desirable limit as per Bureau of Indian Standards (Indian Standard Drinking Water Specification (Second Edition) IS:10500. Indian Standard Institute, New Delhi, pp 1–18, 2012. Elzwayie et al., 2017 made suggestions for monitoring the heavy metals in lakes and rivers. They submitted that the pollution of surface waters is significant, albeit on local scales. However, the heavy runoff associated with perennial rainfall may mitigate the impact of such pollution. Several small and heavy industries being located haphazardly, mainly near metropolitan centers. No centralized sewage system exists, and the industrial effluent from factories is often discharged untreated into streams, lagoons, open drains, and other water bodies.

Rout et al., 2018 studied the Corrosivity Ratio (CR) of ground water of BBN area and the value was reported less than 1. This could be an eye opener for the locality. Many studies suggested that if the quality as well as quantity of water will decrease up to a certain level then it could unfit for domestic use, reduces the agriculture and industrial productions also. Therefore, water is considered as a key input for sustainable development. Dev and Bali, 2019 evaluated the quality of ground water in Kangra district of Himachal Pradesh. It was noticed that slightly acidic to basic pH ranging from 6.57 to 8.4 in pre monsoon while during the post monsoon it varies from 6.29 to 8.31.

The heavy metal status of Sirsa river flowing through Baddi Barotiwala Nalagarh (BBN) industrial region was assessed by Bhardwaj et al., 2019. The mean value of Heavy metal pollution index (HPI) and Metal index (MI) was reported as 999 and 13, respectively and water was rated under poor to very poor category. A study was carried out to analyze the physicochemical parameters of Prashar lake during November 2015–October 2016.The purpose of the study different analysis has been done to check the water quality of the Prashar Lake. Water quality was evaluated seasonally by using water quality index. WQI ranged between 23 and 50 in different

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seasons (winter > spring > autumn > summer > monsoon). (Kumari and Sharma, 2019)

Mazhar et al., 2020 studied the hydrochemistry of the ground water of Ramganga aquifer of U.P. and found that heavy metal polluted the ground water beyond the permissible limits for drinking purposes.

Nguyen et al., 2020 examined the seasonal and spatial distribution of heavy metals and metalloids in the sediments from the Saigon river, Vietnam. Hierarchical cluster analysis was conducted on the entire data to classify sampling sites in to two groups having similar heavy metal concentration and an interesting finding from the study was that the exchange of heavy metals and metalloids from one site to another will take place.

The review of literature reveals that, there are no scientific studies has been reported on the water quality status and physio-chemical properties of different riverine of Baddi Area. The maximum industrialization and urbanization are around this study area. So, the present investigation and research will focus on the major four riverine of Baddi area of solan district of Himachal Pradesh, India.

Research Gap identification:

It is apparent from the literature survey that global water pollution is the biggest issue of concern in the whole world. Water is uniquely vulnerable to pollution due to its property as universal solvent. Now the matter of water quality has become a threat and it's a global demand of today to get clean water for a healthy world.

It is clear from the literature review that so many researches have been made to study many physico- chemical parameters of water in World, Asia, India, Himachal Pradesh and even Solan. But it has been noticed that there was no systematic study carried out for physical, chemical and heavy metal analysis in different rivulets and riverine of Baddi area of Himachal Pradesh. Baddi is an industrial town which is the Asia's biggest pharmaceutical hub.

As per the data provided by the HP State Pollution Control Board, the BBN area today has a total of 2063 operational industrial units of which 176 are red category, 779 are orange and 1108 fall under the green category respectively and total no of industries in Baddi are 1909 which is a huge amount. The cumulative effect of

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population, industrialization and urbanization degrading the quality of air, soil and water and the whole ecosystem. It has been noticed that the domestic sewages and some industrial effluents of the study area goes directly or indirectly in these riverine of the area. In view of this, present work needs to be undertaken and an attempt has been made to carry out the study of Physical, chemical and heavy metal parameters in water sample of these riverine with identification of water quality status by WQI and effect of seasonal variation over it.

Proposed Methodology:

The water quality analysis of four riverine of Baddi area will be carried at different sampling station on each riverine. Samples are selected and collected from twelve sampling stations for the analysis of physical, chemical and heavy metal parameters. This study was carried out for whole one year to examine the seasonal variations.

1. **Sampling Stations:** In order to establish the base for the analysis and study of the water pollution in the Baddi area, the sampling stations will be chosen on the basis of a greater number of Industrialization and population associated to it. For the study four main riverine of Baddi area will be Balad Khadd, Ratta Khadd, Manpura Khadd and Bagbania Khadd. In each riverine three sampling stations will be selected which are as follows:

   1.1 SRB-1 (First Sampling Station on Balad Khadd): It is located in Baddi near the S. P. office and Jhar Majri. This is the first sampling point on the starting edge of the source.

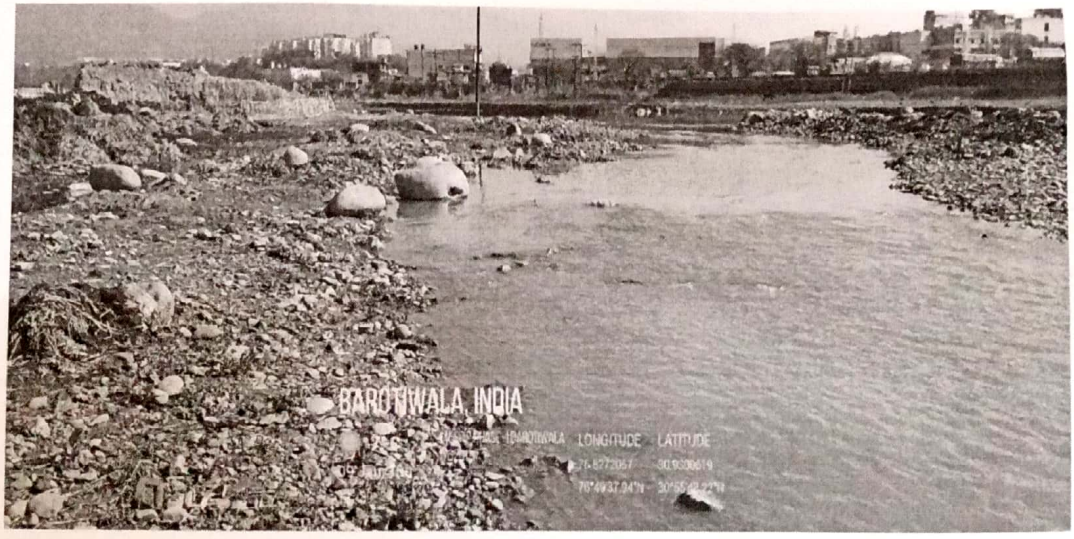

Figure 1: SRB-1 located near SP office Baddi.

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1.1.1 Pollution Sources: Sampling station selected on the basis of industrial wastages and Slum huts nearby the sampling stations which areshown in the figure 2.

Figure 2: Pollution Sources near first sampling station SRB-1.

1.2 SRB-2 (Second Sampling Station on Balad Khadd): It is located with sun city road of BBNDA colony of Baddi. It is present on the middle edge of the source.

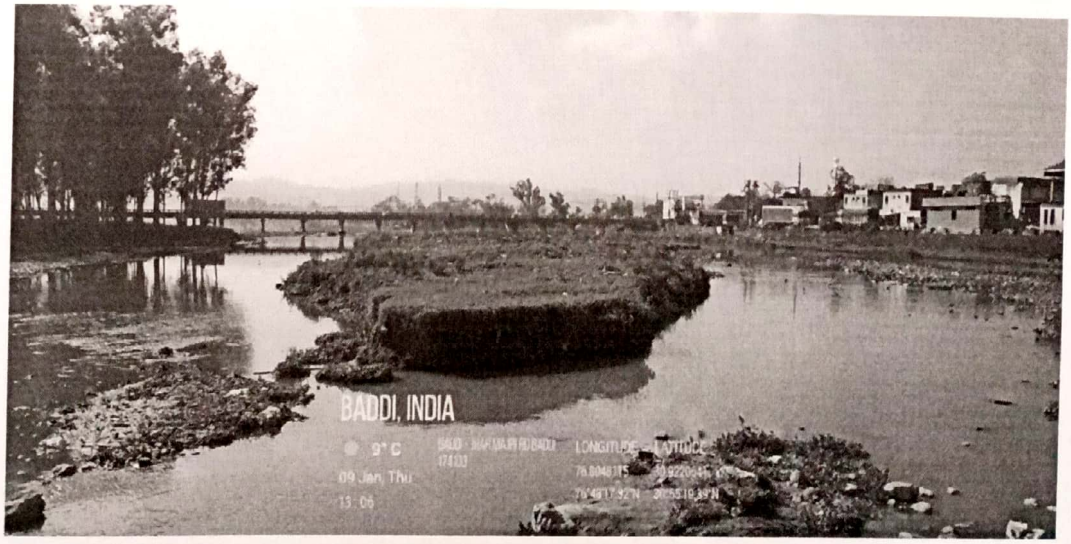

Figure 3: SRB-2 located near BBNDA colony Baddi.

1.2.1 Pollution Sources: Sampling station selected on the basis of industrial wastages and colony nearby the sampling station which shown in the figure 4.

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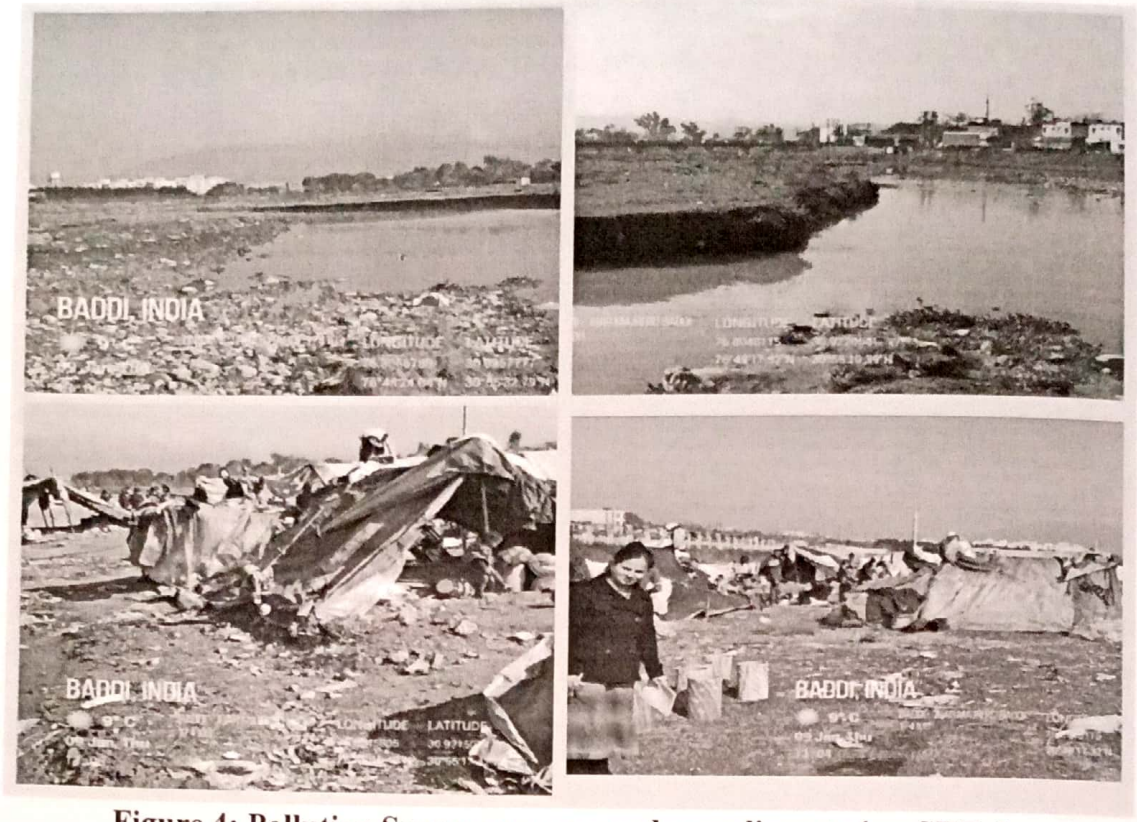

Figure 4: Pollution Sources near second sampling station SRB-2.

1.3 SRB-3 (Third Sampling Station on Balad Khadd): It is located near Stone crasher and Toll Barrier Baddi and present on the last edge of the source.

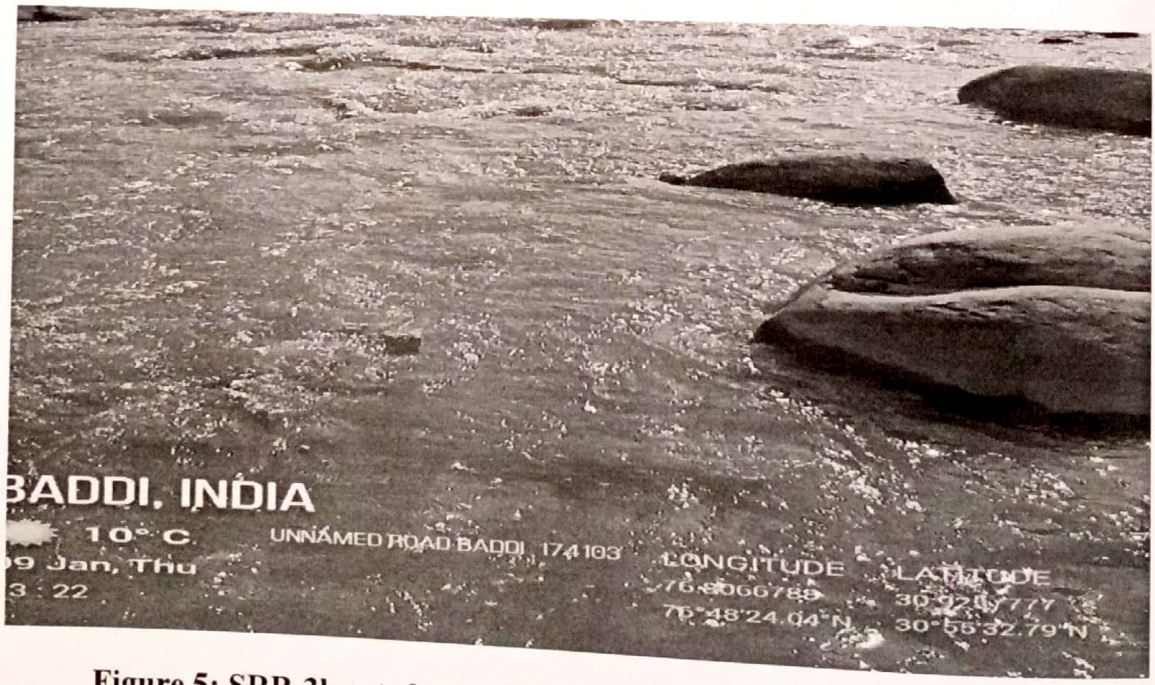

Figure 5: SRB-3located near Stone crasher & Toll Barrier in Baddi.

1.3.1 Pollution Sources: This sampling station was chosen on the basis of industrial and Slum huts wastages on the surface water of the Baddi as shown in figure 6.

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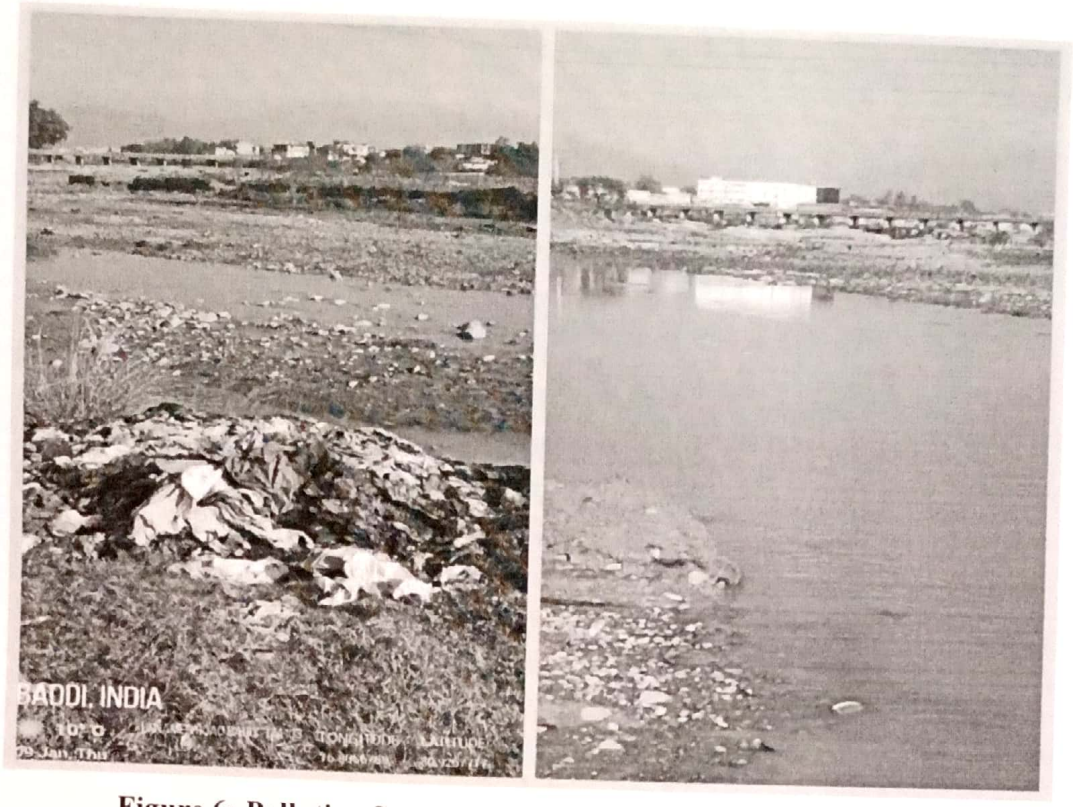

Figure 6: Pollution Sources near third sampling station SRB-3.

1.4 SRR-1(First Sampling Station on Ratta Khadd): It is a located near Bhoop Nagar village of Baddi which is on the first edge of the source.

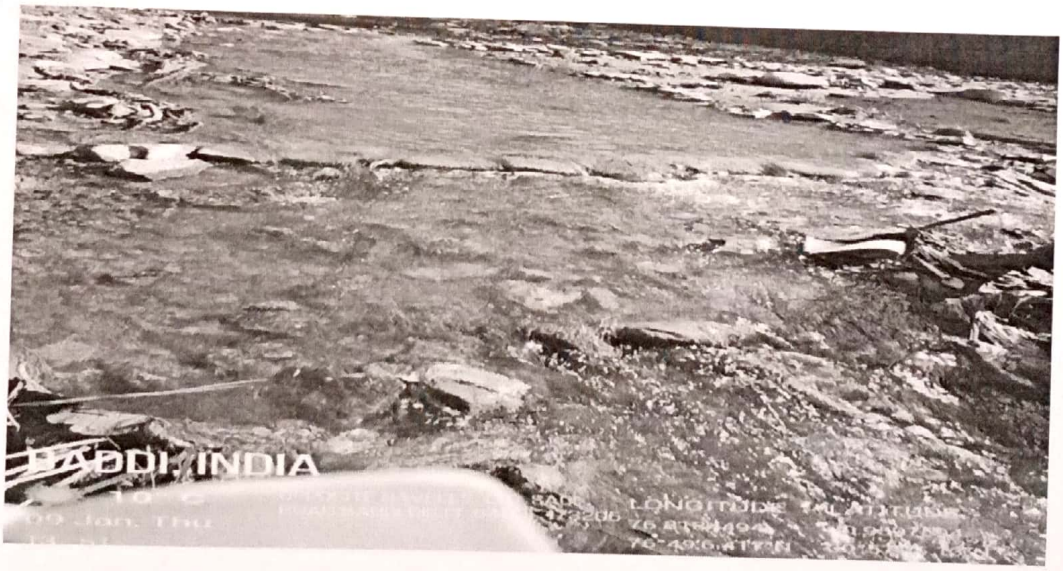

Figure 7: SRR-1 located near Bhoop Nagar in Baddi.

1.4.1 Pollution Sources: Sampling station chosen on the basis of industrial wastages released nearby the sampling station which is shown in figure 8.

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Figure 8: Pollution Sources near sampling station SRR-1.

1.5 SRR-2 (Second Sampling Station on Ratta Khadd): It is located near the Bhood Barrier in the Baddi on middle edge of the source.

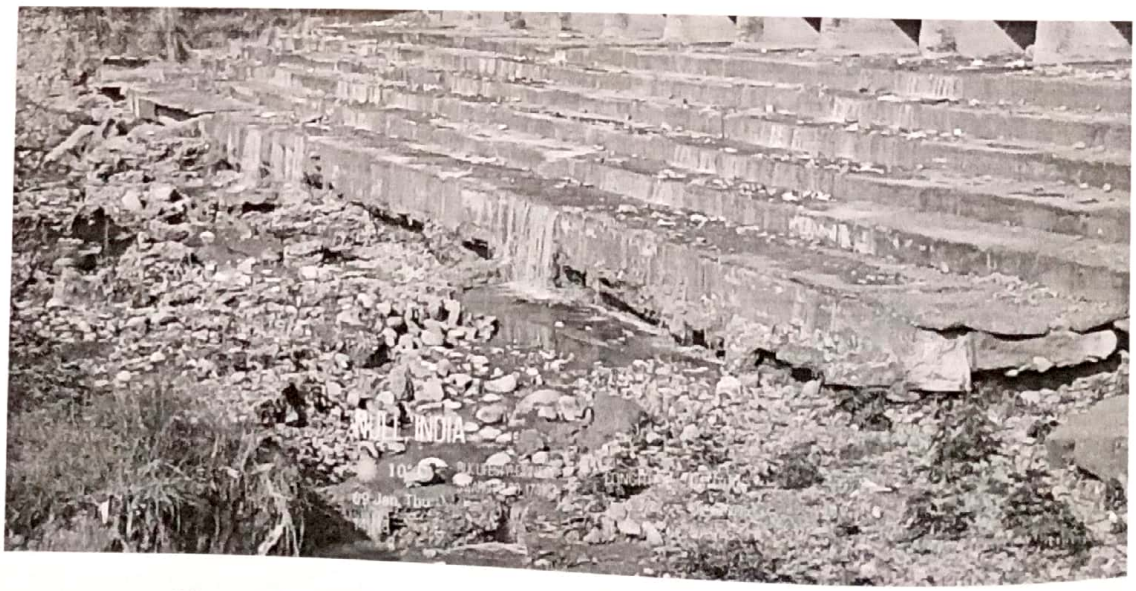

Figure 9: SRR-2 located near Bhood Barrier in Baddi.

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1.5.1 Pollution Sources: Sampling station chosen on the basis of industrial wastages released openly nearby the sampling station which shown in the figure 10.

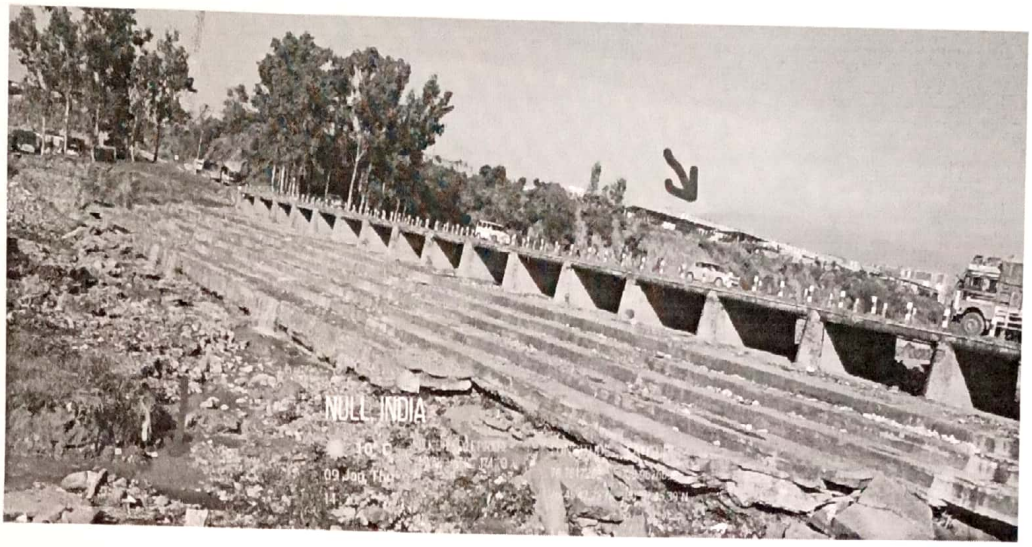

Figure 10: Pollution Sources near second sampling station SRR-2.

1.6 SRR-3 (Third Sampling Station on Ratta Khadd): It is located near village Chunri where Ratta Khadd meets to the Sirsa River. This is present on the last edge of the source.

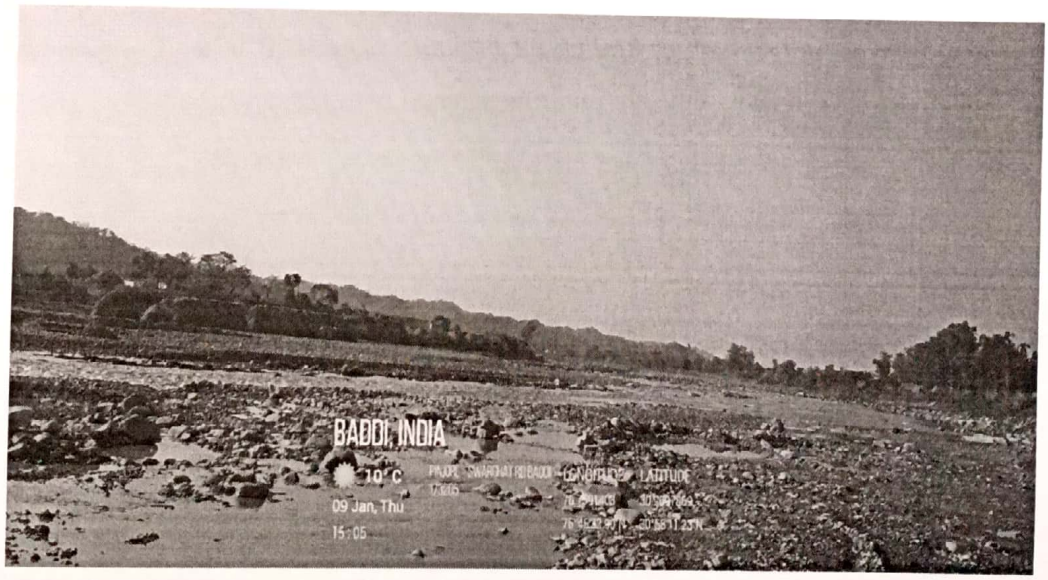

Figure 11: SRR-3 located in village Chunri of Baddi.

1.6.1 Pollution Sources: Sampling station chosen on the basis of industrial wastages released openly nearby the sampling station which shown in the figure 12.

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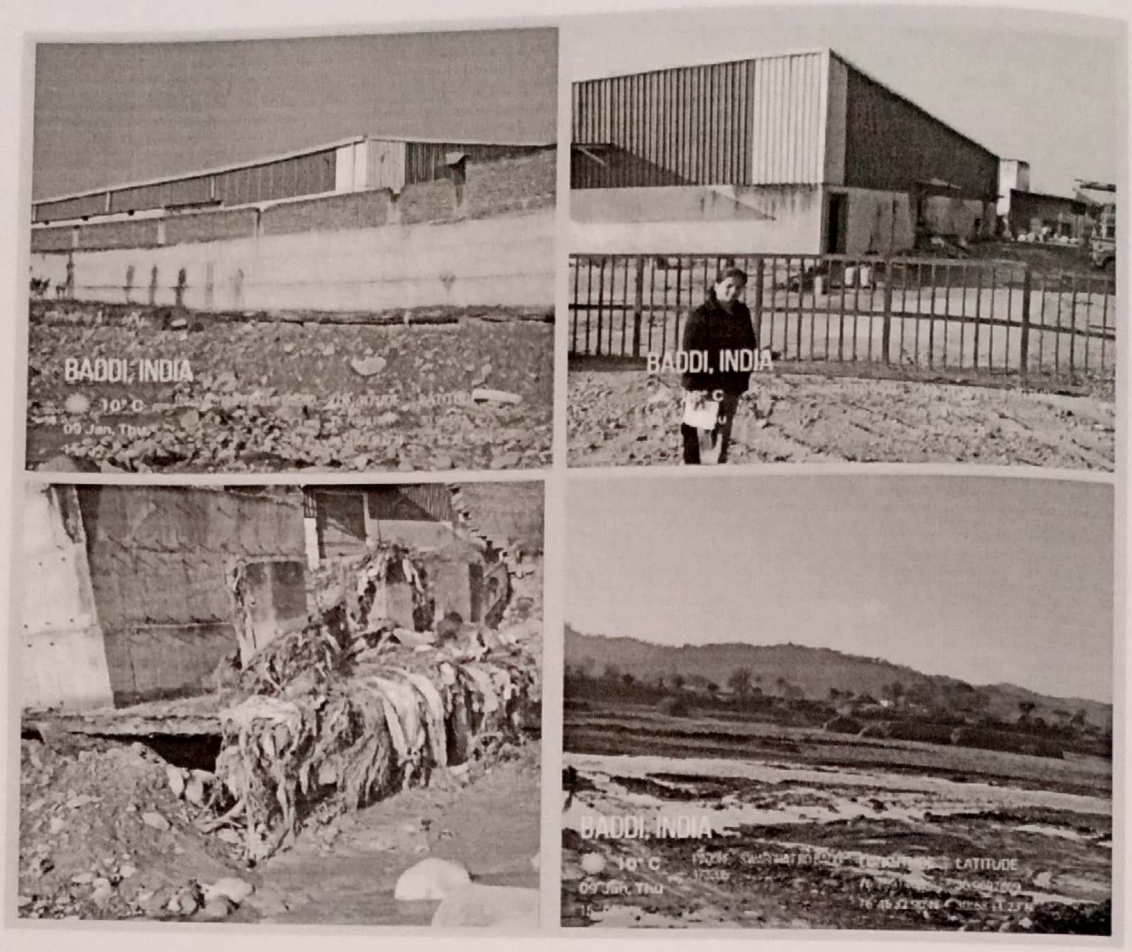

Figure 12: Pollution Sources near third sampling station SRR-3.

*1.7 SRM-1 (First Sampling Station on Manpura Khadd):*It is the first point of Manpura khadd located in vanbirpur village near Lodhi Majra of Baddi.

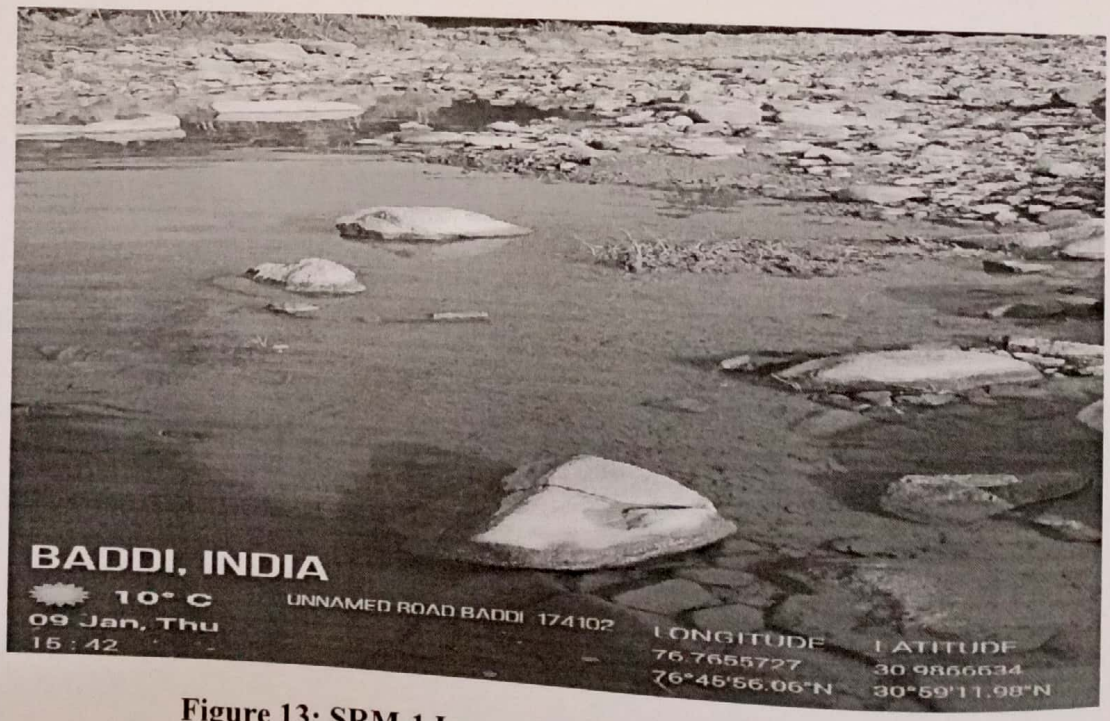

Figure 13: SRM-1 Located in Lodhi majra of Baddi.

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1.7.1 Pollution Sources: Sampling station is away from the industries. It seems to be clean source of water as shown in figure14.

Figure 14: Less Pollution Sources near sampling station SRM-1.

1.8 SRM-2 (Second Sampling Station on Manpura Khadd): It is located at Dabur chowk near Manakpur village of Lodhi majra. It is the middle point of the source.

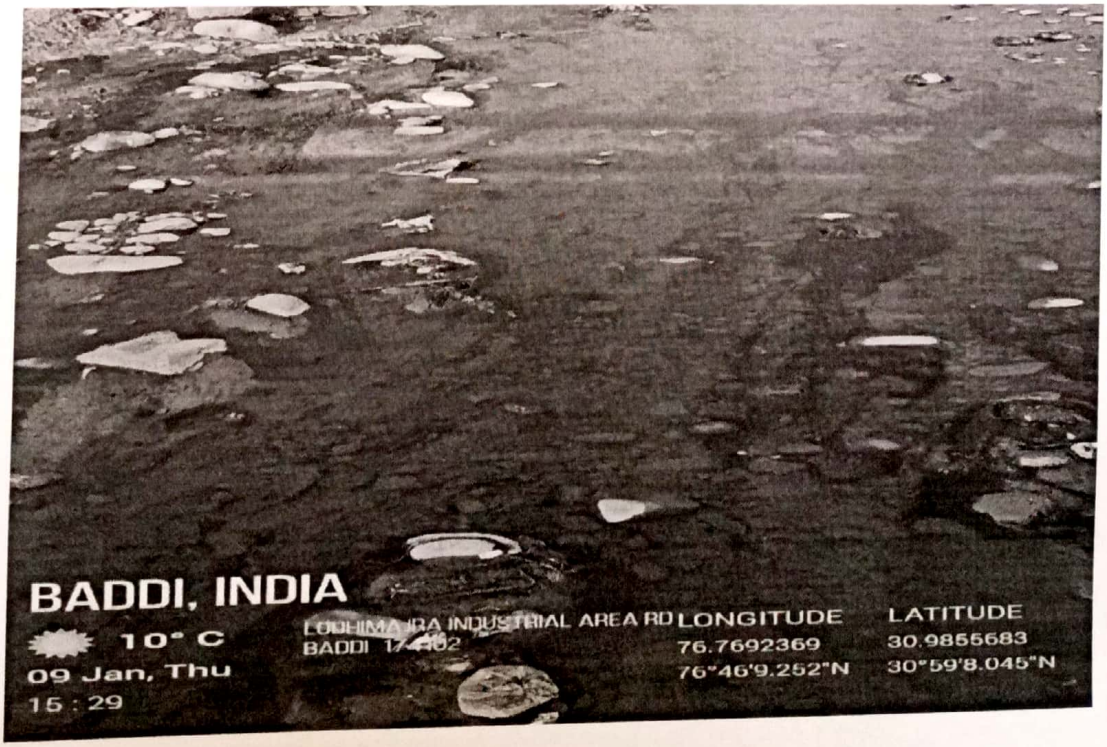

Figure 15: SRM-2 Located at Manpura in Baddi.

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1.8.1 Pollution Sources: Sampling station chosen on the basis of wastages released by industries and slum huts nearby the sampling station as shown in figure 16.

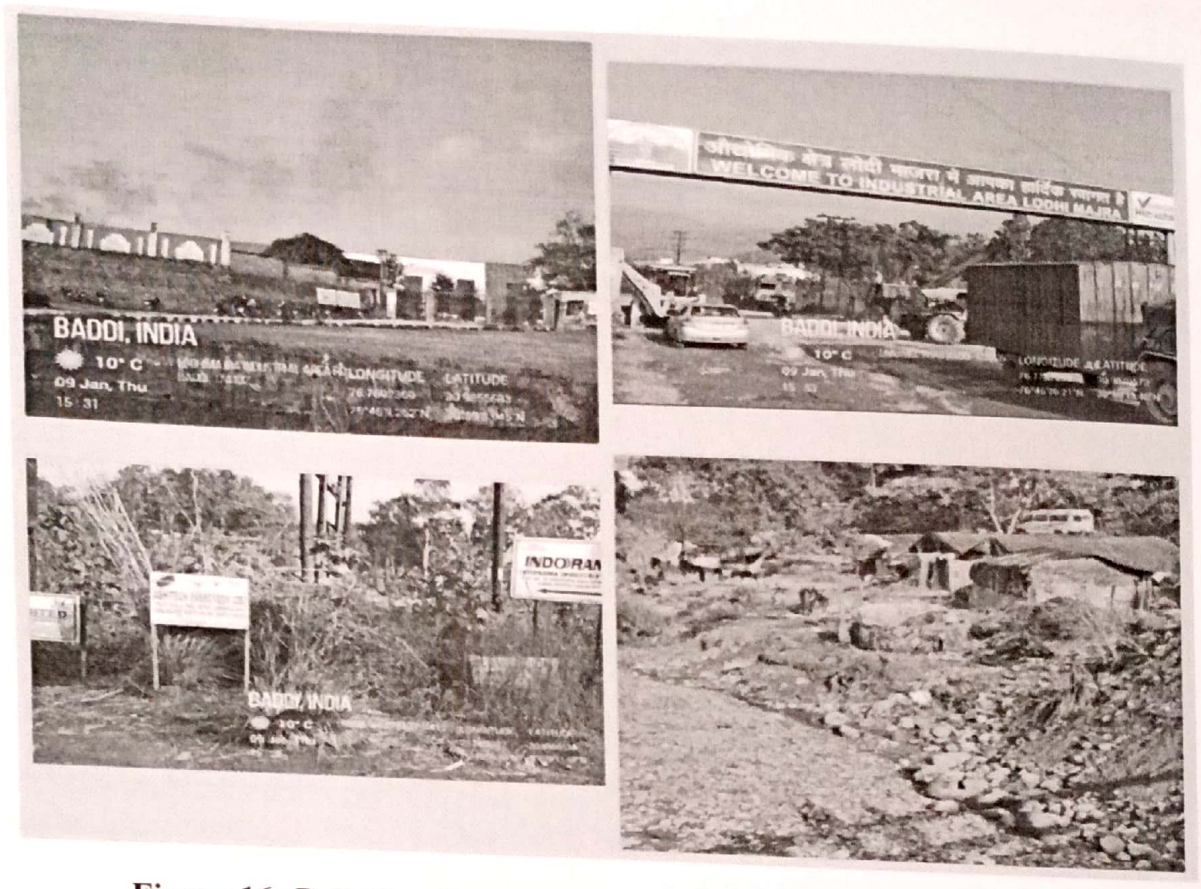

Figure 16: Pollution Sources near second sampling station SRM-2

1.9 SRM-3 (Third Sampling Station on Manpura Khadd): It is located near the Le-Marit hotel of Manpura in the Baddi. It is the last point of the source.

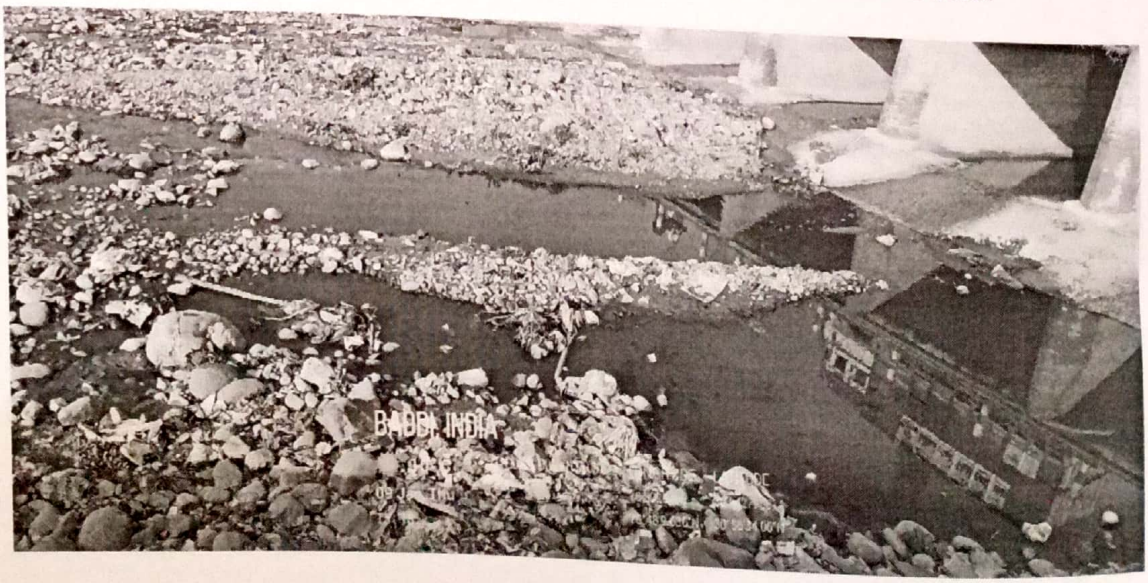

Figure 17: SRM-3 Located in Manpura of Baddi.

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1.9.1 Pollution Sources: Sampling station chosen on the basis of industrial wastages released nearby the sampling station which shown in the figure 18.

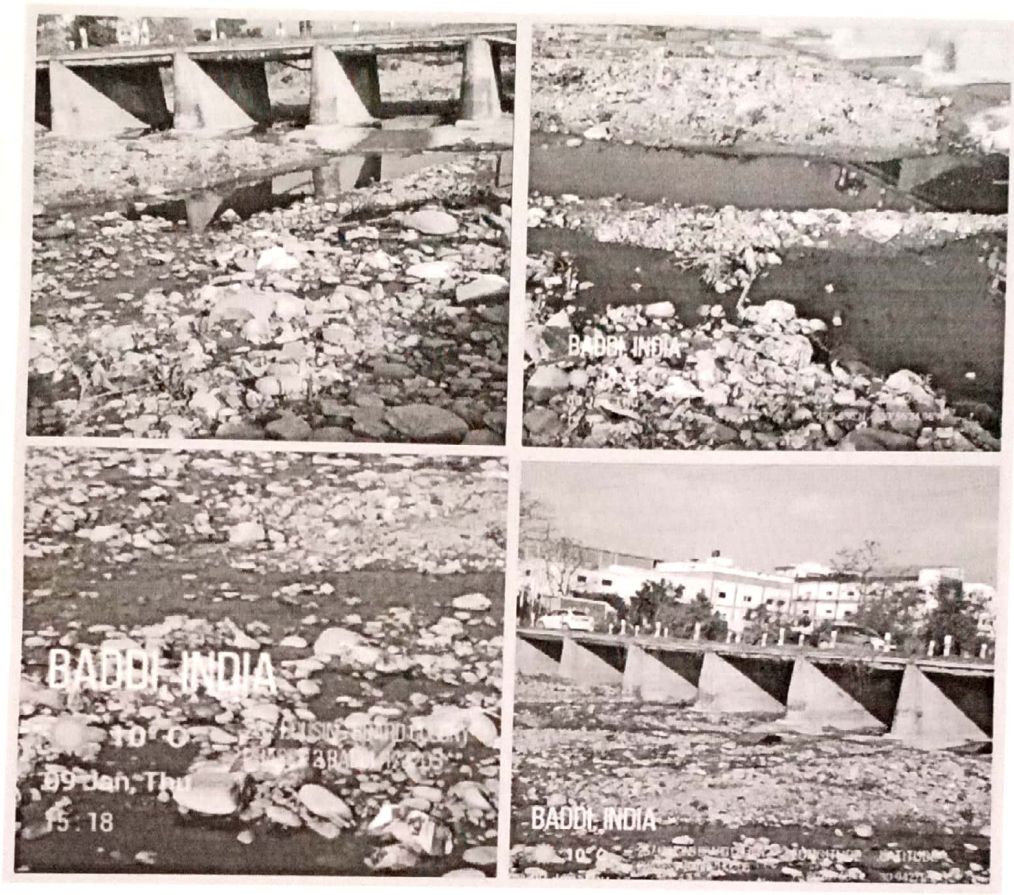

Figure 18: Pollution Sources near third sampling station SRM-3.

1.10 SRBB-1 (First Sampling Station on Bagbania Khadd): It is located in village Baghbala of Nadpur near papad factory. This is the first point of the source.

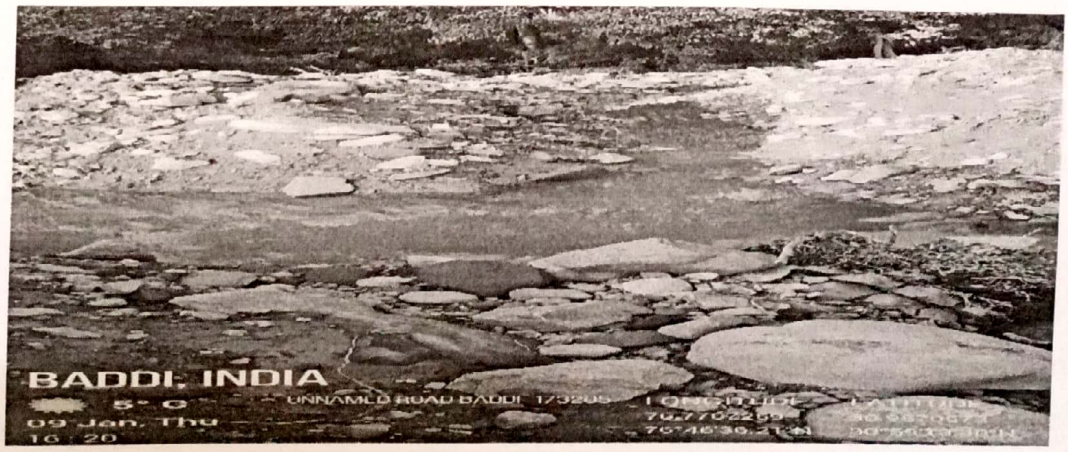

Figure 19: SRBB-1 Located in village Baghbala of Nadpur.

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1.10.1 Pollution Sources: This sampling station seems to be clean due to less industrialization in the area as shown in the figure 20.

Figure 20: Very less Pollution Sources near first sampling station SRBB-1.

1.11 SRBB-2 (Second Sampling Station on Bagbania Khadd):It is located near PRS station Board Bagbania of Saned in Baddi. It is the middle point of the source.

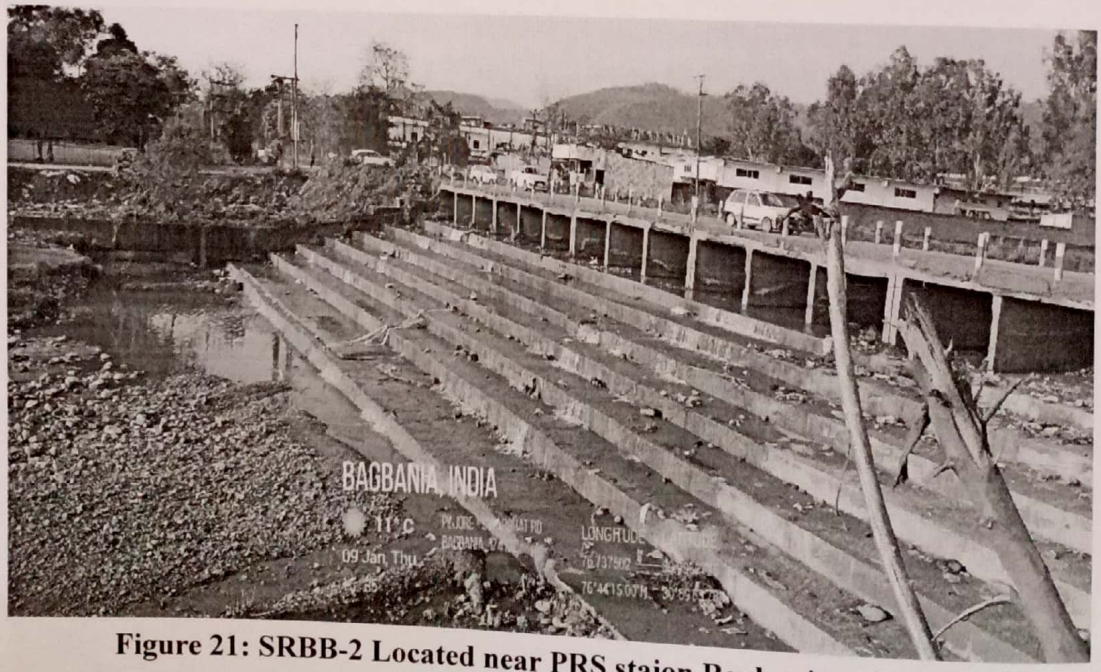

Figure 21: SRBB-2 Located near PRS staion Bagbania in Baddi.

1.11.1 Pollution Sources: Sampling station selected on the basis of industrial wastages nearby the sampling station which shown in the figure 22.

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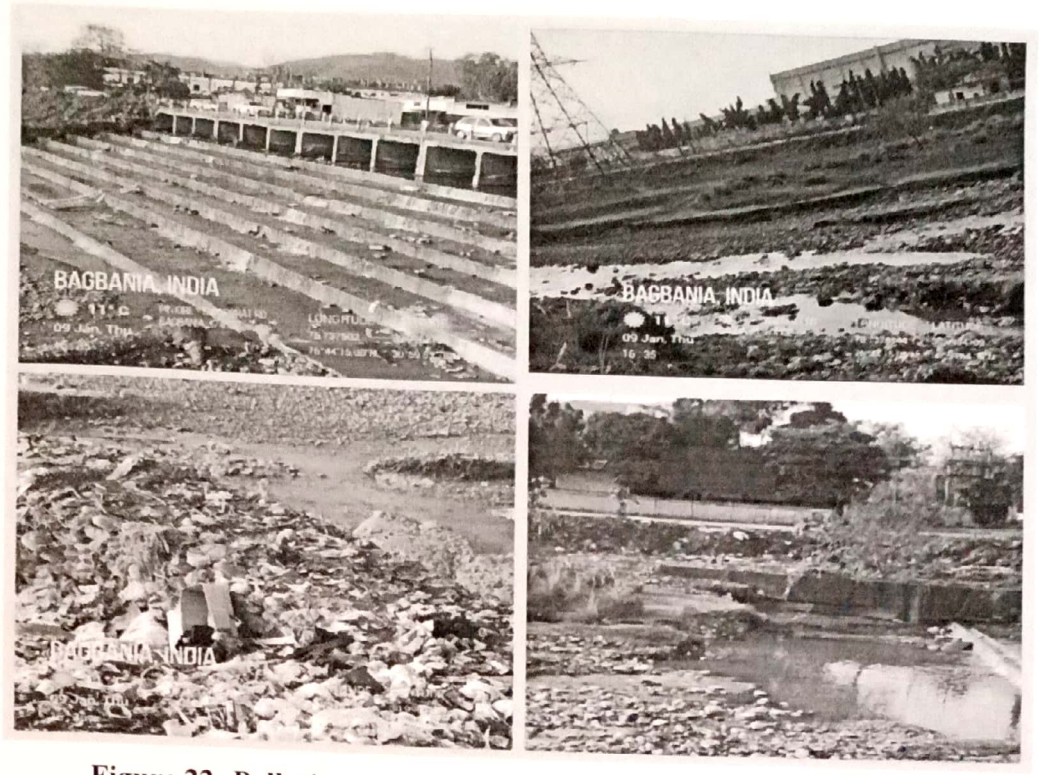

Figure 22: Pollution Sources near second sampling station SRBB-2.

1.12 SRBB-3 (Third Sampling Station on Balad Khadd): It is located on the last edge of the source Bagbania khadd where it meets to the Sisra river.

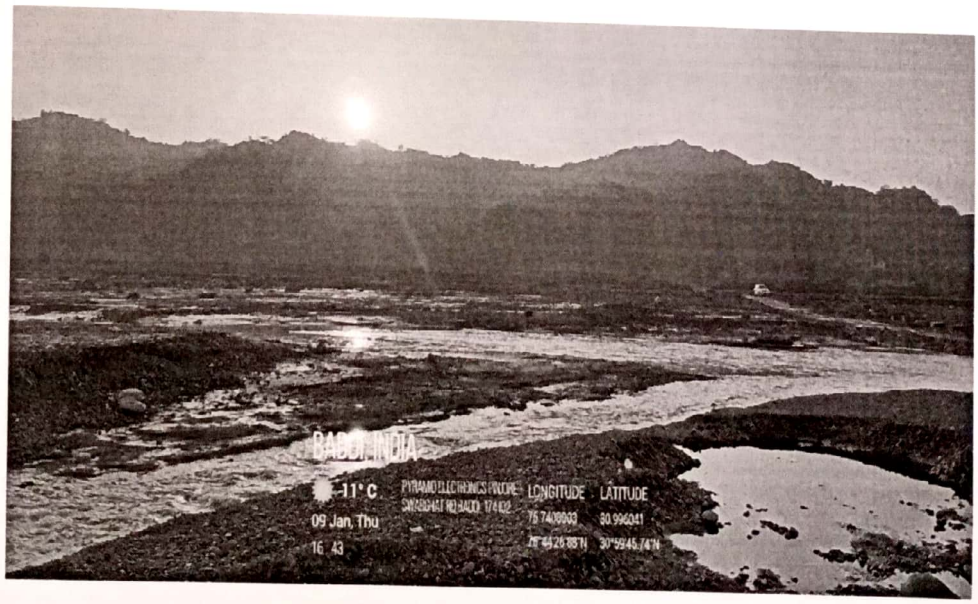

Figure 23: SRBB-3 Located near Saned panchayat in Baddi.

1.3.1 Pollution Sources: This sampling station was chosen on the basis of industrial and Slum huts wastages on the surface water of the Baddi as shown in fig. 24.

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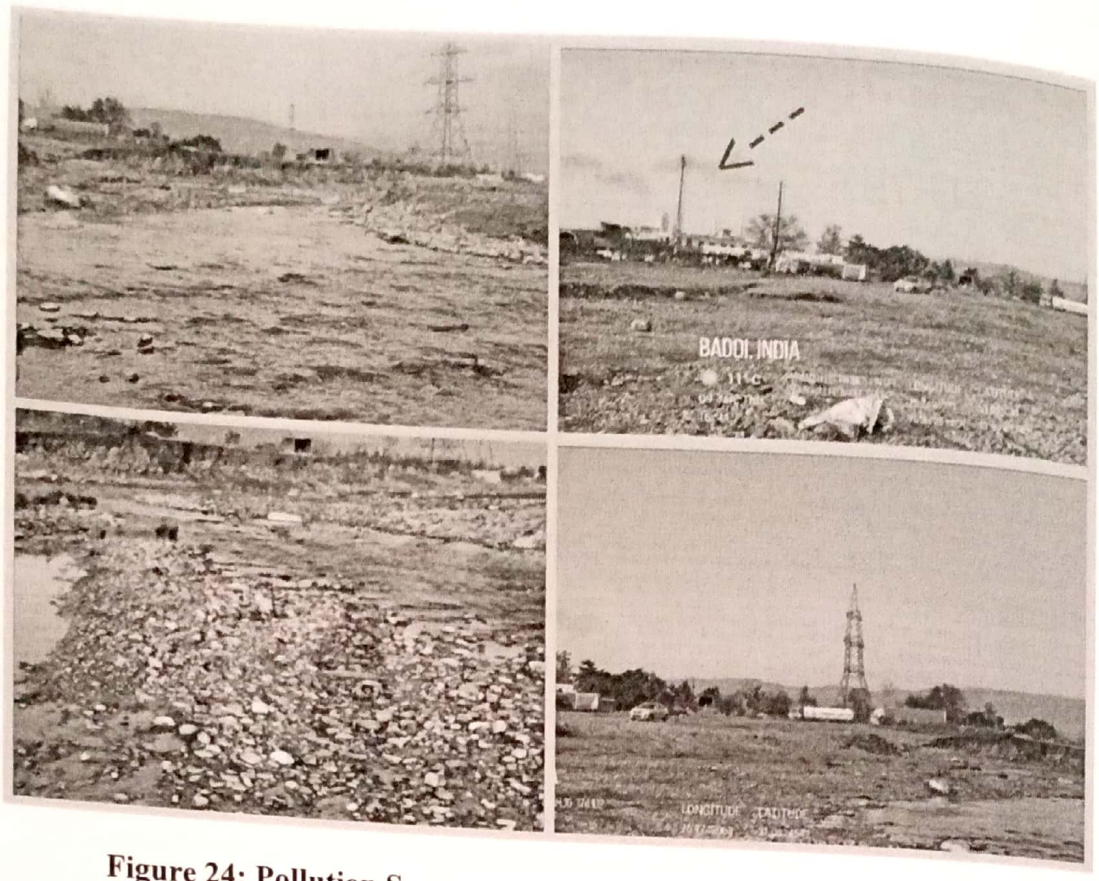

Figure 24: Pollution Sources near third sampling station SRBB-3.

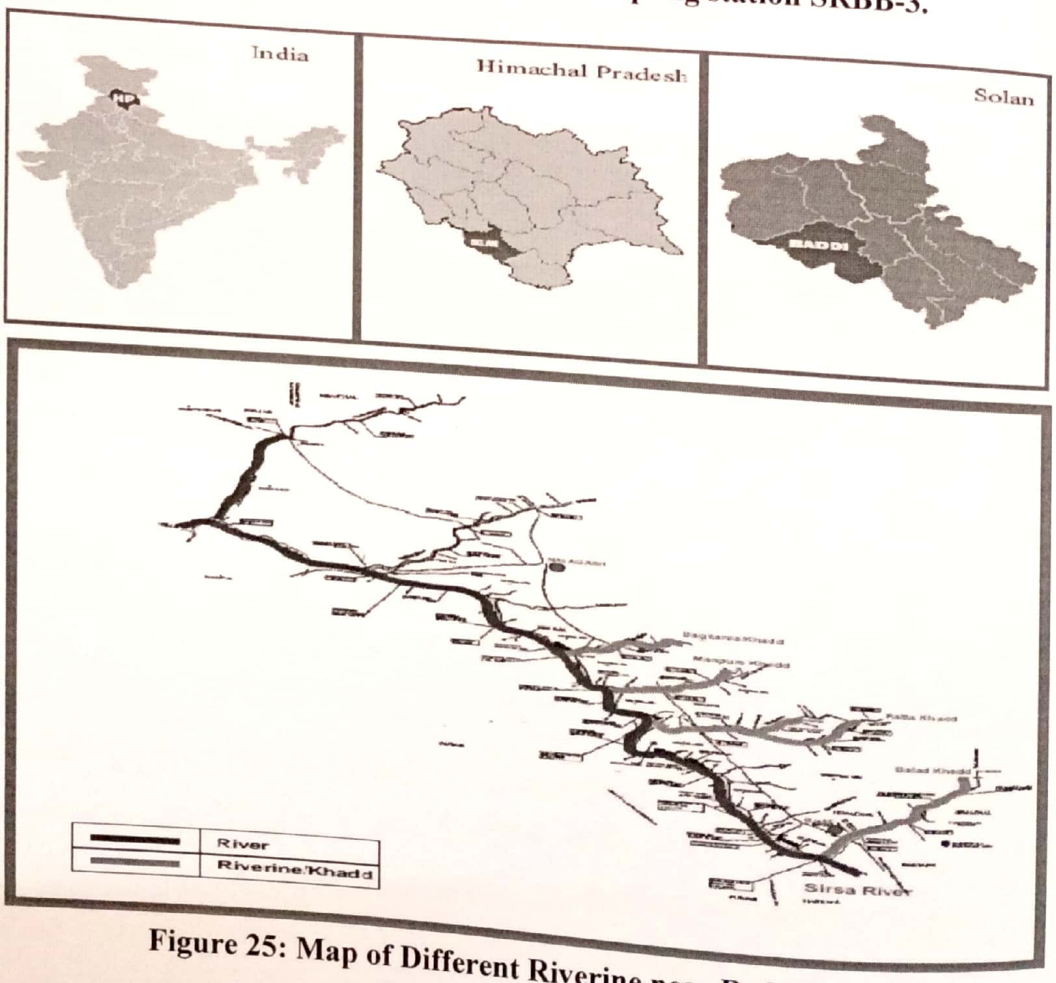

Figure 25: Map of Different Riverine near Baddi.

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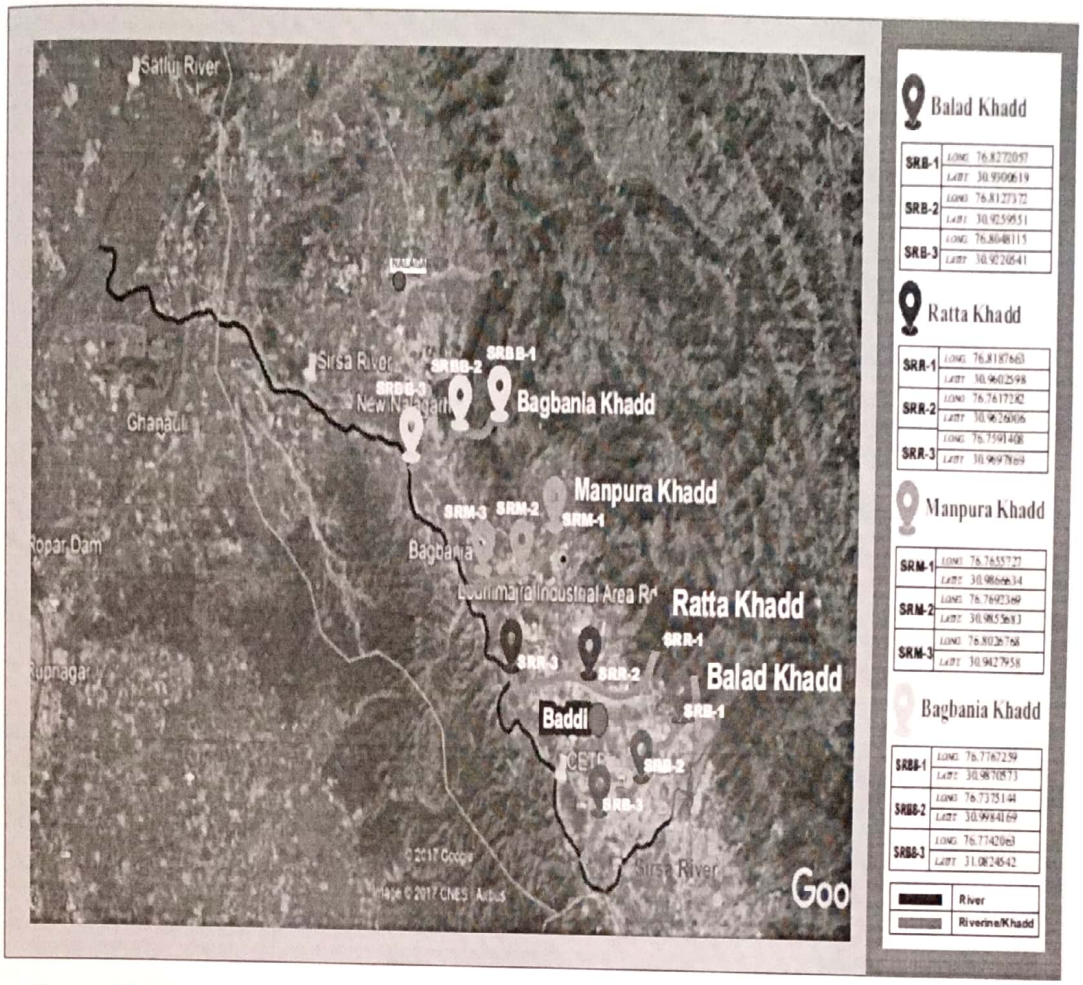

Figure 26:Locations of proposed sample stations with Longitude and latitude position.

2. Sampling Programme: The water samples of four main riverine of Baddi area will be collected from three points of each riverine therefore total twelve sampling stations will be chosen for analysis of physical, chemical and heavy metal parameters of the source for the whole one year.

3. Sampling Procedure: The samples from the selected sampling station will be firstly screened by 1mm sieve and then with the help of funnel it is collected in clean pre rinsed polythene bottles.

4. Parameters to be analyzed: The Physical, chemical and heavy metal parameters of water will be analyzed by standard methods for the Examination of Water and Wastewater, 22nd edition by American Public Health Association. The various parameters recruit for analysis of Riverine water under present study will be as given in table 1.

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Table 1: List of Various parameters employed for the analysis of Riverine water at different selected sampling stations.

Sr. No.	Parameters	Method
1.	Biological Oxygen Demand (BOD) mg/L	3-Day BOD Test (APHA 22nd Ed.- 5210 B)
2.	Calcium Hardness mg/L	EDTA Titrimetric Method (APHA 22nd Ed.- 3500 B)
3.	Chemical Oxygen Demand (COD) mg/L	Nomagraphic Determination (APHA 22nd Ed.- 4500-CO_2)
4.	Chloride (as Cl^-), mg/L	Argentometric Method (APHA 22nd Ed.- 4500B)
5.	Copper (as Cu) mg/L	Atomic Abosrption Spectrophotometric (AAS)
6.	Conductivity µmho/cm	Electrical Conductivity metre.
7.	Cromium (as Cr) mg/L	Atomic Abosrption Spectrophotometric (AAS)
8.	Iron (as Fe) mg/L	Phenanthroline Method (APHA 22nd Ed.- 3500-Fe B)
9.	Lead (as Pb) mg/L	Atomic Absorption Spectrophotometric (AAS)
10.	Magnesium Hardness	By Calculation (APHA 22nd Ed.- 3500 B)
11.	Nitrate (asNO_3^-) mg/L	Ultraviolet Spectrophotometric Screening Method (APHA 22nd Ed.- 4500-$N0_3$-B]
12.	Potassium	Flame Photometric Method (APHA 22nd Ed.- 3500- K B)
13.	pH	pH Meter Method
14.	Total Hardness mg/L	EDTA Titrimetric Method (APHA 22nd Ed.- 2340 B)
15.	Total Dissolved Solids mg/L	TDS Method (APHA 22nd Ed.- 2540 C)
16.	Turbidity	Nephelometric Method (APHA 22nd Ed.- 2130 B)
17.	Fluoride	Ion Selective Electrode Method (APHA 22nd Ed.- 4500-$\bar{F}$ C)
18.	Sodium	Flame Emission Photometric Method (APHA 22nd Ed.- 3500-Na B)
19.	Cadmium	Atomic Absorption Spectrophotometric (AAS) Method

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20.	Zinc	Atomic Absorption Spectrophotometric (AAS) Method
21.	Sulphate	Capillary Ion Electrophoresis Method (APHA 22nd Ed.- 4140)

The Water Quality Index (WQI) is calculated by using the expression given in following Equation:

$$WQI = ™ \sum qn\ Wn / \sum Wn$$

Where; qn = Quality rating of n^{th} water quality parameter;

Wn= Unit weight of n^{th} water quality parameter.

The ranges of WQI, the corresponding status of water quality and their possible use are summarized in table given below:

Table 2: Water Quality Index values and their possible uses.

Sr. No.	WQI Value	Status	Possible Usages
1	0-25	Excellent	Drinking, Irrigation and Industrial
2	25-50	Good	Domestic, Irrigation and Industrial
3	51-75	Fair	Irrigation and Industrial
4	76-100	Poor	Irrigation
5	101-150	Very poor	Restricted use for Irrigation
6	Above 150	Unfit for Drinking	Proper treatment required before use

Proposed Objectives:

This present research work is undertaken with following objectives:

1. To analyses the Physical parameters of riverine of Baddi.
2. To analyses the Chemical parameters of riverine of Baddi.
3. To investigate the kinds of heavy metals in the riverine of Baddi.
4. To check the water quality status by WQI for making water trends of one year.
5. To study the impact of seasonal variation with Physical and chemical parameters of the water.
6. Development/ Suggestions/ Recommendations for remedial measure of water quality of riverine of Baddi area.

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Thesis Outline:

The Thesis will comprise of five chapters as:

Chapter 1: Introduction: - It includes the detail of water, its importance, availability, its correlation with health, its role in ecosystem. Surface water with its sources. Pollution problems in the surface water mainly in rivers and riverine, need and objectives of the present study.

Chapter 2: Literature Review: - It gives detailed knowledge of published literature with reference to water, its sources, Surface water systems, water pollution and its status in the world, India and Himachal Pradesh. It includes the pollution problems specifically in the rivers, rivulets, tributaries and riverine in the Solan district of Himachal Pradesh.

Chapter 3: Methodology: - It is peer- reviewed developed methods and Materiality used including the laboratory resources in the research cycle. It includes the required materials and technologies adopted for carrying out present investigation. This chapter also contains the selection of the sampling stations on the riverine and all the sampling techniques which help in identification of WQI of the study area.

Chapter 4: Results and Discussion: - This chapter describes the significance of my findings related to the research problem being investigated and also explains other new understanding that emerged as a result of the problem. It includes the detailed results of the research obtained and will be presented in tabular as well as graphical form. It also contains the explanation of results of Physical, chemical and heavy metal parameters of the sampling station with seasonal variation for one year. Interpretations of the results belong to the discussion section of the thesis.

Chapter 5: Conclusions: - It is a piece of completion that restate our thesis and summarizes the whole results briefly and concisely. It includes some development/ Suggestions/ Recommendations for remedial measure of water quality of riverine of Baddi area. It also illustrates some future scopes of further research on the basis of suggestions.

Chapter 6: References: - All the material which is consulted from the literature during the research will be written in the form of references which is according to the ACS guidelines 2006.

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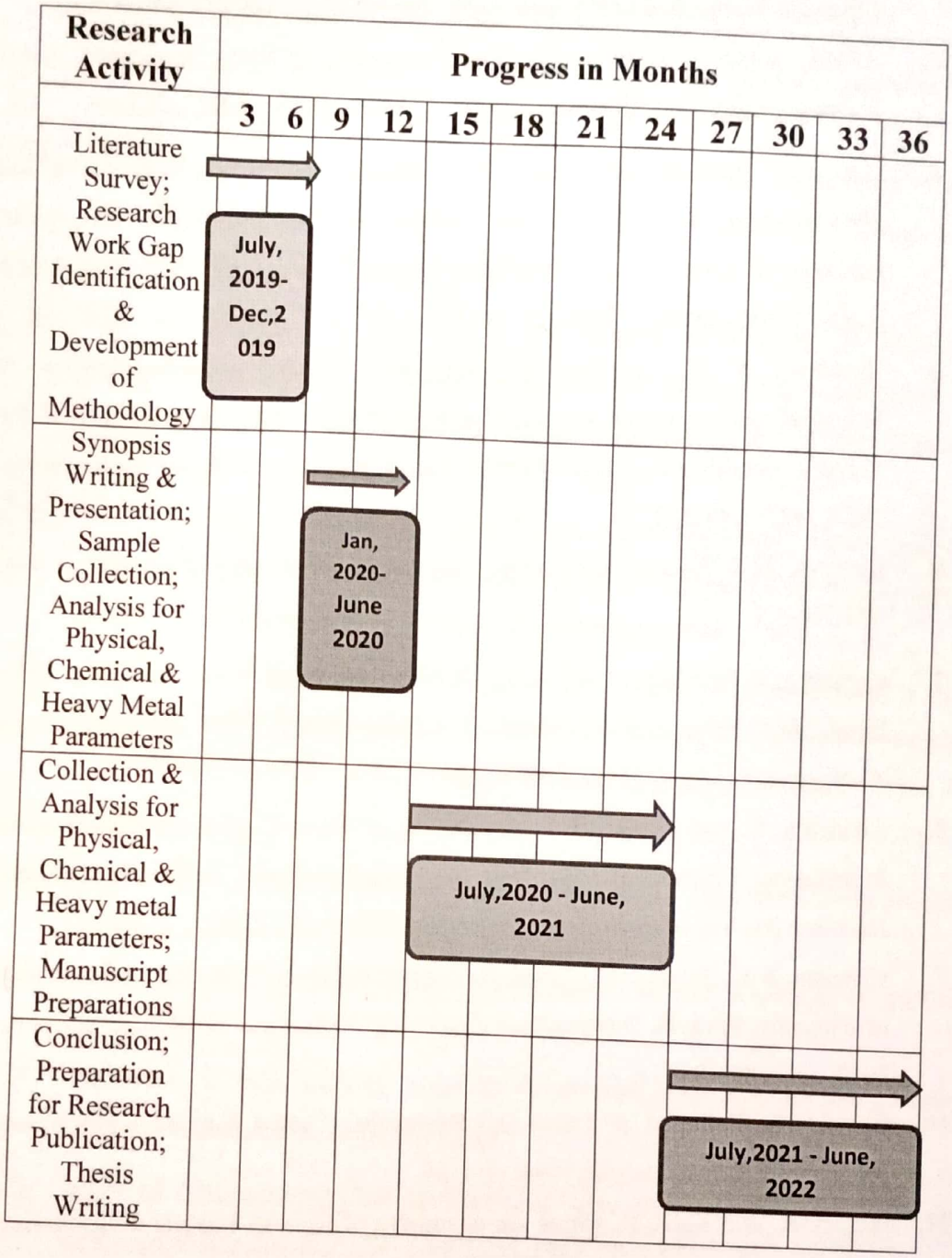
Research Plan Schedule:



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